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"QLISP for Parallel Processors"

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Final report: Qlisp Stanford Task 8 -- July 15, 1986 - July 31, 1988

The goal of the Qlisp project at Stanford is to gain experience
with the shared-memory, queue-based approach to parallel Lisp, by
implementing the Qlisp language on an actual multiprocessor, and by
developing a symbolic algebra system as a testbed application. We
have been successful in achieving the parts of this work that we set
out to do in the first phase of the project, though more remains to be
done. We anticipate continuing this work during the next phase of the
project.

The Stanford staff working on Qlisp have been Prof. John McCarthy
(principal investigator); research associates Lester Earnest, Arkady
Rabinov, Igor Rivin and Carolyn Talcott; graduate students Kelly Roach
and Joseph Weening; and programmer Dan Pehoushek. Richard Gabriel at
has led the subcontract at Lucid, Inc. to produce the Qlisp
implementation on the Alliant FX/8. [See attached report from Lucid]

Before an initial version of Qlisp became available, effort was spent
in setting up the Alliant system and in discussing aspects of the
language design and implementation that needed to be clarified. This
included the following:

1. Defining the semantics of dynamic variables in Qlisp (deep binding).

2. Revising the description of the catch/throw forms.

3. Integrating "futures" into the language specification.

The Multilisp system (by Halstead at MIT) was ported to the Alliant by
Weening in an attempt to have a system in which to test out ideas in
parallel programming, but it proved unsatisfactory. This led to the
implementation of a continuation-passing simulator for parallel Lisp.
This simulator was used as an experimental tool until the first
working versions of Qlisp arrived. The experiments performed on the
simulator included:

1. Algorithms for sorting and basic data structure manipulation for
polynomials.

2. Partitioning and scheduling methods for parallel programming.

3. Parallelizing the production rule system OPS5. (This experiment
was done by Hiroshi Okuno, a visitor from NTT in Japan.)

Once the Qlisp system on the Alliant became usable, the programs
developed for the simulator were used as tests. In addition, work on
the symbolic algebra system was begun by Rivin and Roach. Experiments
by Rabinov and Rivin on a parallel algorithm for computing the
greatest common divisors of polynomials (a basic operation in symbolic
algebra) were used as an initial test of programming in Qlisp.

The symbolic algebra system is now mostly complete as a sequential
Lisp program, and has passed a large suite of tests. Work on
parallelizing it is beginning and is providing insight into the
debugging and performance monitoring tools that are needed.

Work by Pehoushek and Weening has shown the need for better process
partitioning and scheduling algorithms than were originally proposed.
The "dynamic partitioning" method has been implemented and shown to be
effective, both in theory and in the running version of Qlisp, on a
large class of programs.

Qlisp -- July 15, 1986 - July 31, 1988
Final status report by Lucid

The first seven months of the contract were spent porting a version of Lucid
Common Lisp to the Alliant FX/8. The next five months were spent in
restructuring this serial, uniprocessor Lisp to run on a multiprocessor. The
remainder of the contract period was spent on implementing Qlisp language
constructs and performing experiments to test the implementation.

The current version of Qlisp implements the basic language constructs in the
original design of Qlisp. These include QLET (both the T and EAGER cases),
QLAMBDA, SPAWN, deep binding, and a preliminary version of futures. Also
included are new constructs such as QWAIT, locks, and events. We have also
developed various debugging aids, for example a history queue mechanism.

Experience gained during the implementation process has resulted in a number
of changes to the original design of Qlisp. This has resulted in a more
consistent language that is easier for programmers to use. A number of new
higher-level language constructs have been designed to further improve the
Qlisp language.

Papers describing the initial implementation of Qlisp and preliminary results
with it were presented to the 1988 ACM Symposium on Parallel Programming and
to the 1988 Lisp and Functional Programming Conference. A third paper
describing the Qlisp language as we see it developing was written and
submitted to the HICSS-22 conference track on Languages for Parallel
Processing.

Submitted separately are copies of the above mentioned papers and
documentation for the current Qlisp system. A tape containing the object
code for Qlisp for the Alliant FX/8 under the Concentrix 4.0 operating system
is available on request.

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